EFFECTS OF APPLIED BEHAVIOR MODIFICATION ON THE MATHEMATICAL LEARNING OF CHILDREN WITH AUTISM

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EFFECTS OF APPLIED BEHAVIOR MODIFICATION ON THE MATHEMATICAL LEARNING OF CHILDREN WITH AUTISM

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ABSTRAK

Kepentingan menggunakan pengukuhan positif untuk menggalakkan tingkah laku yang diingini atau mengatasi masalah tingkah laku autisme telah dibuktikan. Kajian ini bertujuan untuk mengkaji keberkesanan pengukuhan positif terhadap tingkah laku pembelajaran matematik kanak-kanak autisme. Kajian ini juga menfokus pada pengaruh pengukuhan positif kepada usaha kanak-kanak autisme menyelesaikan tugas dan pengurangan masalah tingkah laku autistik. Dua puluh orang kanak-kanak autisme menyertai kajian ini. Kaedah pemerhatian yang menghasilkan data kuantitatif dan kualitatif digunakan untuk mengkaji kesan pengukuhan positif. Kajian ini terdiri daripada sepuluh sesi yang merangkumi tiga fasa yang berbeza: permulaan, intervensi dan penerusan. Instrumen kajian ini ialah lembaran kerja matematik yang terdiri daripada lima soalan penambahan dengan digit kurang daripada 10. Para peserta dikehendaki melengkapkan lembaran kerja secara individu pada setiap sesi. Pengukuh positif jenis makanan diberikan kepada kanak-kanak selepas mereka mempamerkan tingkah laku pembelajaran yang diingini (jawapan betul). Bilangan jawapan betul, jangka masa yang diambil untuk menyelesaikan tugas, dan tingkah laku kanak-kanak semasa menjawab soalan diperhatikan dan dicatat. Kaedah “Repeated measures ANOVA” digunakan untuk menguji hipotesis kajian ini. Hasil kajian menunjukkan perbezaan yang signifikan dalam pencapaian

matematik dan tingkah laku pembelajaran kanak-kanak autisme pada keseluruhan sesi. Bilangan jawapan betul yang diberikan oleh kanak-kanak autisme menunjukan peningkatan yang signifikan melalui penyampaian pengukuh positif. Selain itu, jangka masa yang diambil untuk menyelesaikan tugasan juga menunjukkan penurunan yang ketara. Di samping itu, kanak-kanak autisme didapati lebih berusaha untuk menyelesaikan tugasan mereka dan mengurangkan tingkah laku autistik dengan penyampaian pengukuh positif. Pelaksanaan pengukuhan positif didapati berkesan terhadap pembelajaran kanak-kanak autisme dan pengurangan tingkah laku autistik. Kesimpulannya, hasil kajian ini menekankan bahawa pengukuhan positif bukan sahaja meningkatkan tingkah laku yang diingini, malah mengurangkan masalah tingkah laku autistik. Tambahan pula, hasil kajian ini meningkatkan pemahaman kita tentang proses pembelajaran kanak-kanak autisme dan kesedaran kita tentang keperluan mereka. Di samping itu, hasil kajian ini memberi panduan yang berguna untuk para pendidik khas bagi merancang sukatan pelajaran sekolah yang berkesan untuk kanak-kanak autisme. Oleh itu, pengajaran kanak-kanak autisme dengan menggunakan pengukuhan positif wajar dilaksanakan. Kekurangan kajian dan cadangan untuk kajian masa hadapan juga dibincangkan.

EFFECTS OF APPLIED BEHAVIOR MODIFICATION ON THE MATHEMATICAL LEARNING OF CHILDREN WITH AUTISM

ABSTRACT

The importance of using positive reinforcement in promoting a desired behavior or addressing behavioral challenges in children with autism has been established in the literature. The aim of this study was to investigate the effectiveness of positive reinforcement on the mathematical learning behavior of children with autism. The present study also examined the influence of positive reinforcement on the efforts to complete tasks and the reduction of disruptive and challenging autistic behaviors. Twenty children with autism participated in this study. An observation that generated quantitative and qualitative data was conducted to examine the effect of positive reinforcement. There were ten sessions of observation in the study, with three different phases: baseline, intervention, and maintenance. The instrument of the present study was mathematics worksheets which consisted of five questions on the topic of additions below 10. The participants were required to complete the worksheet individually during each session. An edible reinforcer was delivered after each desired outcome (correct answer) for their mathematical learning bahavior. The number of correct answers given, length of time spent to complete tasks, and behaviors were observed and recorded. Repeated measures ANOVA was used to test the hypotheses of present study. Results indicated that there were significant differences in mathematics achievement and learning behavior of children with autism across the sessions. There was a significant increase in the number of correct

answers given by children with autism with the delivery of a positive reinforcer. Also, the length of time that they took to complete the mathematics tasks decreased significantly. Further, children with autism were found to put in more effort in answering the questions and reduce autistic behaviors when there was a positive reinforcer. Implementation of positive reinforcement was found to be effective to improve the learning outcomes of children with autism and to reduce autistic behaviors. As a conclusion, the findings of the present study provided further support for the idea that learning and problematic autistic behaviors may be amenable to modification in children with autism via positive reinforcement. In addition, it enhanced our understanding of the learning process of children with autism and also created awareness about their needs. Also, these findings would be useful in assisting special educationists to develop an effective school syllabi meant for children with autism. Therefore, a further step of teaching children with autism by using positive reinforcement should be implemented. Lastly, limitations of the study and suggestions for future research were also discussed.

CHAPTER 1

INTRODUCTION

1.1 Background

Autism was first described by Kanner (1943) who used the term "autism" independently to label a disorder of children who usually, but not always had a low IQ. It is a life-long developmental disability that commonly presents in early childhood and has varying degrees of severity. Childhood autism and related conditions can be defined by the presence of severe language impairment, poverty of social interaction and repetitive stereotyped patterns of interests, behaviors, and activities in place of the imaginative and social pursuits of normal children.

Autism not only affects children from all socioeconomic and ethnic backgrounds, it also places a tremendous economic burden on affected families and society. Worse is the fact that there has been an increase in the number of cases of autism today, both locally and globally. In Malaysia, one in 625 children born has been diagnosed under autism (Dolah, Yahaya, & Chong, 2011). According to National Autism Society of Malaysia (NASOM), the number of children with autism in the organisation's intake has increased 30% over the last three years (NASOM, 2012).

Brown and Snell (2000) identified mathematics as a key area of academics for children with autism (Brown & Snell, 2000). Studies revealed that children with autism were more likely to have associated learning difficulties in reading, writing, language and mathematics (McConachie & Diggle, 2006; Minshew, Goldstein, Tylor, & Sieger, 1994). Visual spatial and motor skills deficits may cause difficulties in

mathematics skills acquisition and frustration in the related learning conditions. However, researchers found that implicit learning is unimpaired in individuals with autism and leads them to have high achievement in specific areas such as mathematics (NASOM, 2012). Therefore, furthering knowledge and designing effective mathematics teaching technique for children with autism would be useful for them and optimizing their mathematical learning behavior.

Positive reinforcement is the most common and widely applied technique in Applied Behavior Analysis (ABA) (Cooper, Heron, & Howard, 2007). It is a method for shaping new behavior or promoting behavioral change. In addition, positive reinforcers refer to those classes of stimuli which, upon presentation, strengthen behavior that they follow. Additionally, edible reinforcer refers to various kinds of food such as raisins, cereals, and biscuits. It is usually used as positive reinforcer in operant experimental studies (Bijous & Sturges, 1959).

We commonly know that there are many related studies conducted in Western countries. However, this study focused in Malaysia. The aim of this study was to investigate the effectiveness of positive reinforcement on the learning behavior of children with autism. Specifically, the present study focused not only on the relationship between positive reinforcement (edible reinforcer) and achievement in learning mathematics (completing mathematics task) among children with autism, but also the influences of positive reinforcement on the efforts to complete tasks and reduction of autistic behaviors. Perhaps by pairing an edible reinforcer with autistic children's mathematical learning behavior, it would be an effective mathematical learning strategy for them, and able to improve their mathematical skills, meanwhile reducing challenging autistic behaviors.

1.2 Statement of the Problem

When we talk about children with autism, people usually "label" them negatively, thinking that they can only have a bleak future, and see the children's problems in terms of neglect or mismanagement (Unicef - Malaysia, 2008). It should be noted that the critical indication of autism is this disorder may develop to be severe to the child in the long-term (Guralnick, 1998). Research indicated that children with autism usually have poor capability to adjust to new environments, fail to adjust life patterns, and lack the development of language (Baranek, 1999; Cox et. al., 1999). Thus, children with autism cannot live alone and have a normal life expectation.

For most parents who have been told that their child is autistic, they typically feel anxious and helpless mainly due to the lack of related information in Malaysia (The Star, 2008). Besides, the high cost of care for children with autism has become a financial load for family (Autism Speaks, 2014). The job of parenting autistic children is not a career of choice of everyone (Yeo et al., 2012). The emotions or behaviors of parents can influence anything that happens to their autistic children (Shamsudin & Rahman, 2014).

The growing prevalence and impact of autism on individuals, families, or the public is still not getting appropriate attention. The community still lacks knowledge and exposure on autism (Jasni, 2011). It leads to the negative mind-set towards children with autism and their family. They are often overlooked by the community, therefore unable to join the community. This has affected the life quality of children with autism (Neni et. al., 2010).

Additionally, children with autism and their family may experience high levels of stigmatization in society. According to Gray (1993), autistic families often

find that public reaction to them is stereotypical and negative (Gray, 1993). Parents' competences are often judged every time their children show inappropriate behavior in public areas. Parents experience stigma and hostile staring by others (Gray, 2002). These situations may cause feelings of embarrassment and distress for parents. It may be a high pressure and tough process for the parents to accept the fact and face the uncertainties in their lives and discriminations from society.

Furthermore, the shortage of special educationists and limited special education catering to children with special needs in Malaysia not only denies the education opportunity for children with autism, it may also cause parents to deny the children's condition, and send them to mainstream schools (Toran, 2011). Worse, many teachers in the mainstream school do not have specific training and they lack knowledge in teaching or handling children with autism (Morrier, Hess, & Heflin, 2011). Therefore, children's educational needs are not meet (Ghafar & Jahaya, 2006; Toran, Yasin, Tahar, & Salleh, 2010). It may become the primary hindering factor for children with autism to have a good educational experience (Starr & Foy, 2010; Whitaker, 2007). Additionally, the current teaching syllabus in mainstream schools is not suitable for children with autism. It caused them to be neglected in their learning stage and cannot adapt to their daily life (Dolah et al., 2011).

Numerous studies in Western countries have found that positive reinforcement was effective in training children with autism (Cicero et al., 2002; Cocchiola et al., 2012; Foxx & Meindl, 2007; Koegel et al., 2012). However, there is still a lack of research on children with autism in Malaysia.

1.3 Importance of the Study

It is crucial that an appropriate and effective teaching strategy be able to support the development of children with autism. This study enables parents or families of children with autism to understand effective ways and techniques of handling their family members who have been affected by autism. Besides, this study provides ways of teaching children with autism at home as well as managing their problem behaviors.

Additionally, this study can create more exposure of autism to public, raising awareness for the society in Malaysia. By increasing the awareness, it is expected that the public will have less negative mind-sets towards children with autism and their families. Also, it adds to the public's understanding of how to deal with children with autism, and therefore improve integration of children with autism into the community.

This study provides information to the teachers on how to teach students with autism effectively. It provides better understanding for teachers on the ways of managing the disruptive behaviors of students with autism, and some strategies to motivate them to learn and participate in classroom activities, as well as how teachers can facilitate positive reinforcement learning on children with autism to help them learn efficiently. Besides, it also provides further knowledge for the educationist to develop an effective school syllabi meant for children with autism.

Findings from this study are important to some parties in Malaysia including the government, NGOs, health care providers, professionals, and educators. This study provides relevant knowledge for them on the learning behavior of children with autism. It serves as guidelines to develop comprehensive and effective strategies

for teaching children with autism. Also, it supports continued development of new and innovative ways of handling challenging behaviors of children with autism.

Lastly, findings on autistic learning from the present study are important to improve the life quality of children with autism. This study may shed some light for local researchers to expand future research on the learning process of children with autism and to identify the effects of positive reinforcement on the mathematical learning behavior of children with autism in Malaysia.

1.4 Research Questions

Based on the statement of problem, this study attempts to answer three research questions:

1. Is there any relationship between number of correct answers given by children with autism and positive reinforcement?

2. Is there any relationship between length of time children with autism spend to complete mathematics tasks and positive reinforcement?

3. Is there any relationship between behaviors of children with autism while completing mathematics tasks and positive reinforcement?

1.5 Research Objectives

Based on the research questions above, there are three research objectives:

1. To examine the relationship between number of correct answers given by children with autism and positive reinforcement.

2. To examine the relationship between length of time children with autism spend to complete mathematics tasks and positive reinforcement.

3. To examine the relationship between behaviors of children with autism while completing mathematics tasks and positive reinforcement.

1.6 Conceptual Definitions

Autism is a lifelong neuro-developmental disorder that appears in the first three years in life (Kanner, 1943). It is characterized by i) persistent deficits in social communication and social interaction; (ii) restricted, repetitive patterns of behavior, interests, or activities; (iii) symptoms must be present in early childhood (but may not become fully manifest until social demands exceed limited capacities); (iv) symptoms together limit and impair everyday functioning; and (v) these disturbances are not better explained by intellectual disability or global developmental delay (APA, 2013).

Positive reinforcement is a method in Applied Behavior Analysis (ABA) for shaping new behavior or promoting behavioral change. A reinforcer is given for a specific desired behavior that increases the likelihood that the behavior will occur again in the future (Scheuremann & Webber, 2002; Skinner, 1953).

Edible reinforcer refers to various kinds of food such as candy, biscuits, and raisins. It is commonly used as positive reinforcer in operant experimental studies (Bijous & Sturges, 1959).

Learning Behavior refers to the responses given by children with autism when they are learning something. Researcher found that learning behavior of children with

autism may correlate with their language impairment, poverty of social interaction and restricted repetitive and stereotyped patterns of behaviors, interests and activities (Baron-Cohen, Wheelwright, & Joliffe, 1997; Preissler & Carey, 2005).

1.7 Operational Definitions

The operational definitions of main terms used in the present study are illustrated below.

Autism refers to persistent deficits in social communication and social interaction, and restricted, repetitive patterns of behavior, interests, or activities. Symptoms must be present in early childhood (but may not become fully manifest until social demands exceed limited capacities) and limit and impair everyday functioning. These disturbances are not better explained by intellectual disability or global developmental delay as based on the criteria (APA, 2013).

Positive reinforcement refers to a method for shaping new behavior, promoting behavioral change, or increasing the likelihood of a desired behavior to occur again in future (In this study, an edible reinforcer is used for positive reinforcement).

Edible reinforcer refers to a type of food named "Mamee". It is given when a specific desired behavior is presented (in this study, answer mathematics question(s) correctly) to increase the occurrence of the desired behavior in future.

Learning Behavior refers to the responses given by children with autism when they are completing mathematics questions. The behaviors include:

1. Showing efforts to answer mathematics questions such as drawing small circles on worksheet and counting to obtain answer, counting fingers, counting out loud, and counting in mind.

2. Appearance of autistic behaviors during learning such as irrelevant and repetitive vocalizations, repetitive motor movements, repetitive object usage and aggression behaviors.

CHAPTER 2

REVIEW OF THE LITERATURE

2.0 Overview

This chapter reviews past studies related to the research topic. Firstly, the definition of autism is presented. The characteristics of autism, sensory features of autism, learning behavior of children with autism, causes of autism, diagnosis of autism, and autism in Malaysia are also reviewed in this chapter. Next, explanation on the definition of positive reinforcement, theory of positive reinforcement, and types of positive reinforcers are given. Finally, a conceptual framework for this study is provided.

2.1 Autism

2.1.1 What is Autism?

Autism was first described by Kanner (1943). It is a life-long developmental disability. It affects areas of the brain that control understanding, emotion, speech, gesticulation, and the general ability to interact socially. Autism is characterized, in varying degrees, by difficulties in verbal and nonverbal communication, social interaction and repetitive behaviors. According to Chakrabati and Fombonne (2005), approximately 6 out of every 1000 individuals had an autism spectrum disorder (Chakrabati & Fombonne, 2005). An interesting finding showed that autism was four times more likely to be diagnosed in boys than girls (Folstein & Rosen-Sheidley,

2001; Hillman et al., 2007). Autism, according to DSM-V (APA, 2013), is described below:

(1) Persistent deficits in social communication and social interaction across multiple contexts, as manifested by the following, currently or by history:

   a. Deficits in social-emotional reciprocity, ranging, for example, from abnormal social approach and failure of normal back-and-forth conversation; to reduced sharing of interests, emotions, or affect; to failure to initiate or respond to social interactions.
   b. Deficits in nonverbal communicative behaviors used for social interaction, ranging, for example, from poorly integrated verbal and nonverbal communication; to abnormalities in eye contact and body language or deficits in understanding and use of gestures; to a total lack of facial expressions and nonverbal communication.
   c. Deficits in developing, maintaining, and understanding relationships, ranging, for example, from difficulties adjusting behavior to suit various social contexts; to difficulties in sharing imaginative play or in making friends; to absence of interest in peers.

(2) Restricted, repetitive patterns of behavior, interests, or activities, as manifested by at least two of the following, currently or by history:

   a. Stereotyped or repetitive motor movements, use of objects, or speech (e.g., simple motor stereotypes, lining up toys or flipping objects, echolalia, idiosyncratic phrases).
   b. Insistence on sameness, inflexible adherence to routines, or ritualized patterns of verbal or nonverbal behavior (e.g., extreme distress at small changes,

difficulties with transitions, rigid thinking patterns, greeting rituals, need to take same route or eat same food everyday).

c. Highly restricted, fixated interests that are abnormal in intensity or focus (e.g., strong attachment to or preoccupation with unusual objects, excessively circumscribed or preservative interests).

d. Hyper- or hypo-reactivity to sensory input or unusual interest in sensory aspects of the environment (e.g. apparent indifference to pain/temperature, adverse response to specific sounds or textures, excessive smelling or touching of objects, visual fascination with lights or movement).

(3) Symptoms must be present in the early developmental period (but may not become fully manifest until social demands exceed limited capacities, or may be masked by learned strategies in later life).

(4) Symptoms cause clinically significant impairment in social, occupational, or other important areas of current functioning.

(5) These disturbances are not better explained by intellectual disability (intellectual developmental disorder) or global developmental delay. Intellectual disability and autism spectrum disorder frequently co-occur; to make co-morbid diagnoses of autism spectrum disorder and intellectual disability, social communication should be below that expected for general developmental level.

2.1.2 Characteristics of Autism

Characteristics that are commonly associated with children with autism include (i) persistent deficits in social communication and social interaction, (ii) restricted, repetitive patterns of behavior, interests, or activities, (iii) symptoms must be present

in early childhood (but may not become fully manifest until social demands exceed limited capacities), (iv) symptoms together limit and impair everyday functioning, and (v) these disturbances are not better explained by intellectual disability or global developmental delay.

Bryson (1996) reported that at least one third of children with autism fail to develop spoken language. Other studies showed that there may be a marked absence or delayed in the use of spoken language with little attempt to use alternative forms of communication, such as gestures (Baranek, 1999; Osterling & Dawson, 1994). According to Wetherby and Prizant (2005), children with autism who want something inaccessible use other person's hand as a tool and lead the person to the object without any verbal communication (Wetherby & Prizant, 2005).

Children with autism commonly engage in "echolalia", which is the repetition of other's speech (Schuler, Prizant, & Wetherby, 1997). Perhaps linked with that, children with autism who use spoken language demonstrate irregular used of verbs, probably because they repeat what they heard rather than attempt to apply grammar rules (Van Meter, Fein, Morris, Water house, & Allen, 1997). Research showed that they have difficulty with the pragmatics of language (Volkmar, Carter, Grossman, & Klin, 1997). Besides, children with autism face difficulty in their spoken language and in initiating or holding a conversation with others (Ghaziuddin & Gerstein, 1996; Landa, 2000), and they use language in an uncommon way.

Charman et al. (2005) reported that the absence of nonverbal behavior such as gesturing in children with autism was significantly associated with delay language development (Charman, Taylor, Drew, Cockerill, Brown, & Baird, 2005). Besides, research found that children with autism tend to have difficulty in using eye gaze

appropriately to initiate or sustain a conversation, and attend to objects or events at any one time (Wetherby, Woods, Allen, Cleary, Dickinson, & Lord, 2004).

The impairment in socialization is also defined as one component in children with autism (Kanner, 1943; Waterhouse, Fein, & Modahl, 1996). Previous research revealed that children with autism do not indicate interest or engage in social referencing (Cox, Klein, Charman, Baird, & Baron-Cohen, 1999) and they do not tend to share information about themselves with others. According to Lord and Magill-Evans (1995) and Sigman and Ruskin (1999), children with autism tend to appear oblivious to the social aspects of interpersonal relationships. They act as though they are not interested in being around others and have far less social interaction than other children, and eventually affect their rate of development (Lord & Magill-Evans, 1995; Sigman & Ruskin, 1999).

The absence of eye gaze in very early life of children with autism has been noted (Wimpory, Hobson, Williams, & Nash, 2000). Research also showed that children with autism are retrospectively described by their parents as avoiding eye contact (Volkmar, Cohen, & Paul, 1986). Adrien (1991) also reported that lack of eye contact makes children with autism face difficulties in initiating or sustaining interactions (Adrien, 1991).

Children with autism have more frequent and persistent repetitive behaviors than typically developing children (Bodfish, Symons, Parker, & Lewis, 2000). These behaviors include stereotyped motor movements, repetitive manipulation of objects, specific object compulsions, rituals and routines, insistence on sameness, and narrow interests (Lewis & Bodfish, 1998; Turner, 1999). Children with autism become upset if the furniture is rearranged or the route to home is different (Volkmar et al., 1997).

Besides, children with autism demonstrate a narrow range of interest that is unusual by developmental standards. They have fixation on objects with poorer social functioning (Klin, Jones, Schultz, Volkmar, & Cohen, 2002b). Researchers found that children with autism prefer objects over people (Dawson, Meltzoff, Osterling, Rinaldi, & Brown, 1998), and specifically to prefer parts of objects rather than the complete whole (Rinhart, Bradshaw, Moss, Brereton, & Tonge, 2000). According to Klin, Jones, Schultz, Volkmar, and Cohen (2002a), children with autism have a tendency to focus on physical features such as light switches and lamps, rather than attend to people (Klin, Jones, Schultz, Volkmar, & Cohen, 2002a).

2.1.3 Sensory Features of Autism

Although unusual sensory features are not thought to be universal in autism, they appear to be highly prevalent, early emerging, and contributing to differential diagnosis and intervention planning (Dawson & Watling, 2000).

According to Kanner (1943) and Wing (1969), there are sensory differences and sensory seeking behavior among children with autism. Most of the children with autism have problems in modulating their response to sensory input such as over or under sensitivity to sound (Rosenhall, Nordin, Sandstroem, Ahlsen, & Gillberg, 1999) and pain. They also face difficulties in maintaining optimal arousal to sensory input and focus attention (Courchesne, Townsend, Akshoomoff, & Saitoh, 1994), fail to orient for social stimuli such as name calling (Dawson et al., 1998), have impairment in visual motion process (Gepner & Mestre, 2002), and have difficulties in tolerating specific sensory experiences such as noisy environments and messy materials (Grandin, 1996).

Studies showed that children with autism prefer to use their peripheral vision (Lord, Cook, Blumenthal, & Amarel, 2000), thereby self-regulate some visual stimuli (Dawson & Lewy, 1989) even when their vision test is normal (Hillman, Snyder, & Neubrander, 2007). They tend to avoid eye contact and instead focus on the mouth or other body parts of another person (Klin et al., 2002b).

Children with autism demonstrate differences in responding to auditory stimuli (Hayes & Gordon, 1977; Rogers et al., 2003), which are present during the first year of life (Dawson, Osterling, Meltzoff, & Kuhl, 2000). Although the results of their learning tests are normal, there seems to be a delay in processing of sounds (Wong & Wong, 1991). They have difficulty in discriminating speech from background noise and show preferences for nonhuman noises over human voices (Klin, 1992a, 1992b).

Many children with autism have been noted to have unusual response to taste and smell (Rogers, Hepburn, & Wehner, 2003), which lead them to consume a limited variety of foods and refuse to eat anything new (Ahearn, 2003; Levin & Carr, 2001). They also appear to have low thresholds for odors (Dunn, Myles, & Orr, 2002; Kientz & Dunn, 1997) and react in ways that would indicate they find many smells offensive (Soussihnan, Schaal, Schmit, & Nadel, 1995).

Researchers found that delays and difficulties in motor development are frequently noted in children with autism (Baranek, 1999, Dawson & Watling, 2000; Manjiviona & Prior, 1995). Impairments in motor development include abnormalities in gross motor skills and fine motor skills. It has been intertwined with the core features of autism and has implications for early development and communicative intent (Rogers & Pennington, 1991). Studies showed that more than 80% of children

with autism are below average in motor skills. Hilton et al. (2012) found that the lower scores in motor skills lead to bigger problems in life such as social impairment (Hilton, Zhong, White, Klohr, & Constantino, 2012).

2.1.4 Learning Behavior of Children with Autism

The prevalence of autism in the population of individuals with learning disabilities is estimated to range from 5% to 40% (Bradley & Bolton, 2006). It is not surprising that intellectual disability in autism correlates with impairment in using social information (Baron-Cohen, Wheelwright, & Joliffe, 1997; Preissler & Carey, 2005).

Researchers found that stimulus over-selectivity phenomenon whereby a person focuses on only one aspect of an object from the environment while ignoring other equally salient aspects (Broomfield, McHugh, & Reed, 2008; Dube & McIlvane, 1999) is a widely acknowledged problem in individuals with autism and limits their ability to learn (Dube & McIlvane, 1999; Reed, Broomfield, McHugh, McCausland, & Leader, 2009). Besides, studies showed that children with autism fail to learn from the typical everyday environment as they are thought not to attend to the salient components of the environment (Klinger et al., 2006; Lovass & Smith, 2003). Eikeseth and Jahr's study (2001) on an autistic child indicated that the child failed to learn any receptive language after undergoing more than 24000 discrete trials (Eikeseth & Jahr, 2001). Additionally, research by Hwang and Hughes (2000) indicated that children with autism fail to generalize the typical skills across contexts when those skills are taught explicitly (Hwang & Hughes, 2000).

Research revealed that mathematics disorder (dyscalculia) has been reported at a prevalence of 3% - 6% in the general population (Shalev, Aurbach, Manor, &

Gross-Tsur, 2000). In a review of mathematical ability in autism, Chiang and Lin (2007) reported that performance of children with autism on the WISC (Wechsler Intelligence Scale for Children) arithmetic subtest is significantly lower (Chiang & Lin, 2007). Besides, Mayes and Calhoun's study (2003) reported that 22% of children with autism face specific learning difficulties in arithmetic (Mayes & Calhoun, 2003).

Besides, language disorders or impairments in autism may cause confusion with mathematics vocabulary such as "add", "minus", "all together" (Lerner, 1993). When children with autism lack language proficiency skills, they face difficulties to acquire and apply mathematical skills and concepts, understand the instructions, and have inability to solve mathematics problems (Minshew, Goldstein, Taylor, & Sieger, 1994). Besides, Joseph, Tager-Flusberg and Lord (2002) reported that students with autism generally exhibit uneven cognitive development by having lower non-verbal skills such as information organizing and problem solving in mathematics (Joseph, Tager-Flusberg, & Lord, 2002).

On the other hand, Baron-Cohen et al. (2001) found that mathematicians significantly have more autistic traits and score higher in the Autism Spectrum Quotient (AQ) than people in other sciences, such as social sciences or medicine (Baron-Cohen, Wheelwright, Skinner, Martin, & Clubley, 2001). Chakrabarti and Fombonne's study (2001) also indicated that autism spectrum conditions are at least three times greater among mathematicians (Chakrabarti & Fombonne, 2001). In addition, a study on tested systemizing talent of individuals with autism revealed that the rate of autism is elevated among siblings and parents of mathematicians (Baron-Cohen, Wheelwright, Burtenshaw, & Hobson, 2007).

A study on comparing arithmetic peak and arithmetic dip showed that students with autism are strong in arithmetic (Jones, Golden, Simonoff, Baird, Happe, Marsden, Tregay, Pickles, & Charman, 2009). Furthermore, Su et al. (2010) indicated that students with high functioning autism have an increased knowledge of mathematics in the project MIND (Math Is Not Difficult) (Su, Lai, & Riviera, 2010). A study by Banda et al. (2007) on using high preference strategy to overcome low preference mathematics tasks in students with autism showed that the use of high preference technique created frequent reinforcement opportunities for students with autism to take less time to complete a lower preference task (Banda, McAfee, Lee, & Kubina, 2007). These studies indicate that designing an effective strategy to improve the mathematics learning behavior of children with autism is essential.

2.1.5 Causes of Autism

Autism is described as "idiopathic", meaning that first causes are unclear. There is no single cause of autism. It is likely that several causal factors are involved, in varying combinations to cause autism (Boucher, 2009). The causal factors fall into two groups, genetic and environmental.

There have been a number of studies of identical and non-identical twins where one or both are affected by autism. These have provided important information relating to genetic factors. Studies showed that in monozygotic twins, one of whom has autism, the autism also occur in the second twin in approximately 60% of cases (Bailey et al., 1995). However, approximately 90% of second twins in dizygotic twins show no signs of autism.

According to Rutter, Silberg, and Simonoff (1999), the chance of an individual with autism to have a brother or sister with full-brown autism is between 2% and 6% (Rutter, Silberg, & Simonoff, 1999); it is far higher than the incidence of autism in the general population. Studies also showed that parents and other close relatives are usually likely to have some slight behavior anomaly, either past or present, which place them within the broader autism phenotype (Dawson, Soulières, Gernsbacher, & Mottron, 2007; Piven, Palmer, Jacobi, Childress, & Arndt, 1997).

On the other hand, different combinations of environmental factors may contribute to autism. One of the risk factors is prenatal environment. Various teratogens such as maternal rubella have the possibility to cause mild or atypical autism (Aarons & Gittens, 1999). Thalidomide, which is a medicine prescribed for morning sickness (Miller et al., 2005), and valproic acid, which is an anticonvulsant medication also contribute to autism (Arndt, Stodgell, & Rodier, 2005). Besides, Cytomegalovirus (CMV) infection during pregnancy can lead to congenital CMV, meaning that the virus is transmitted to the unborn baby via placenta, and enters the unborn baby's system where it can have devastating, even fatal, birth defects or developmental anomalies including autism (Sweeten, Posey, & McDougle, 2004; Yamashita, Fujimoto, Nakajima, Isagai, & Matsuishi, 2003).

Beversdorf et al. (2005) reported that exposure to stress during the first three months of pregnancy or experiencing stressful life events during pregnancy can be a risk factor for autism (Beversdorf, Manning, Hillier, Anderson, Nordgren, Walters, Nagaraja, Cooley, Gaelic, & Bauman, 2005). Besides, heavy smoking or alcohol abuse (Fombonne, 2002; Miles, Takahashi, Haber, & Hadden, 2003) in early pregnancy increase the risk factors for childhood autism. Perinatal risk factors such

as a prolonged or difficult birth increase the chances of later development of autism (Bolton, Murphy, Macdonald, Whitlock, Pickles, & Rutter, 1997; Rutter, 2005) and later language impairment (Stromswold, 2006).

2.1.6 Diagnosis of Autism

There is not yet a biological marker for autism (Baron-Cohen, 2008). A diagnosis of autism is made on the basis of an observed or described behavioral profile, which is characterized by both the absence of typical behaviors as well as the presence of atypical behaviors (Lord & Risi, 2000). Studies showed that different methods provide different types of information; diagnoses are most accurate and stable when based on information obtained from multiple sources (Chawarska, Klin, Paul, & Volkmar, 2007; Lord, Risi, DiLavore, Shulman, Thurm, & Pickles, 2006). An earlier diagnosis and collaborative assessment are more reliable than a diagnosis by a single person (Risi, Lord, Gotham, Chrysler, Corsello, Szatmari, Cook, Leventhal, & Pickles, 2006).

According to Lord's earlier parent interview study (2008), children who do not understand any words out of context at age two and do not use any words have a high probability of having autism (Lord, 2008). Approximately 20% of children with autism experience a regression in language or social behaviors (Lord, Shulman, & DiLavore, 2004; Volkmar, Chawarska, & Klin, 2005). These problems almost always occur before the age of 24 months (Charwaska, Paul, Klin, Hannigen, Dichtel, & Volkmar, 2007; Ozonoff, Williams, & Landa, 2005).

The Autism Diagnostic Observation Schedule-Generic (ADOS-G; Lord et al., 2000) and the Autism Observation Scale for Infants (AOSI; Bryson, Zwaigenbaum,

McDermott, Rombough, & Brian, 2007) provide opportunities for the clinician to observe social communication and play behaviors in standardized or semi structural contexts. The ADOS-G has four modules that can be used with children as young as two through adolescence and adulthood, and designs to elicit information in the areas of communication, reciprocal social behaviors, and restricted and repetitive behaviors. In addition to ADOS-G, the AOSI intends to acquire the same types of information as the ADOS-G, but it is specifically designed for infants under 18 months (Chawarska, Klin, & Volkmar, 2008).

According to Rutter, LeCouteur, and Lord (2003), the most widely used and well-established semi-structured interview to diagnose autism is the Autism Diagnostic Interview-Revised (ADI-R; Rutter, LeCouteur, and Lord, 2003). The ADI-R is supplemented by information from ADOS (Lord, Rutter, DiLavore, & Risi, 1999). The ADI-R provides quantifiable scores related to severity symptoms in the area of communication, reciprocal social interaction and restricted and repetitive behaviors. ADI-R can be used for children from two to eleven years old and it requires approximately two hours to administer. Boucher (2009) pointed out that ADI-R is a method of assigning an individual to a diagnosis group and obtaining information about his/her current strengths and needs (Boucher, 2009).

The Diagnostic Interview for Social and Communication Disorders (DISCO; Wing, Leekam, Libby, Gould, & Larcombe, 2002) is another semi-structured interview. It consists of wider range of questions to diagnose autism and other developmental disorders. Besides, the Childhood Autism Rating Scale (CARS; Schopler, Reichler, & Renner, 1988) is a 15 items screening instrument, and each

category is scored on a Likert type scale from 1 to 4. The higher a child scores, the more extreme or autistic-like the behavior.

Another screening measure is the Social Communication Questionnaire (SCQ; Rutter, Bailey, & Lord, 2005). A child must be four years old before he/she can be evaluated with this instrument. It requires parents or caregivers to assess their child's behavior over a three month period and provides a general cut-off score to determine whether or not a child should receive a more comprehensive assessment.

The Social Responsiveness Scale (SRS) is a 65-item rating scale to identify children as young as four years old who would follow a clinical assessment for autism (Constantino et al., 2003).

The Checklist for Autism in Toddlers (CHAT; Baron-Cohen et al., 1996) comprises 14 different items that include elements of parental and clinical observation. It is effective in identifying children with autism at 18 months old (Baron-Cohen, Allen, & Gillberg, 1992). It is a popular tool among clinicians and researchers during routine check-ups.

The Modified Checklist for Autism in Toddlers (M-CHAT) (Robins, Fein, Barton, & Green, 2001) is an extended version of the CHAT, and designed for use on toddlers (Hillman, Synder, & Neubrander, 2007). Williams and Brayne's study (2006) showed that the specificity and sensitivity of this checklist is satisfactory when used with selected groups of children (Williams & Brayne, 2006).

2.1.7 Autism in Malaysia

In Malaysia, Autism Spectrum Disorder is the fastest growth disorder (Sin Chew Daily, 2012). Research showed that one in 625 children born has been diagnosed under autism (Dolah, Yahaya, & Chong, 2011). With 15 million children below the age of 15 in this country, it is estimated that at least 20,000 children below the age of 15 have autism (Toran, 2011). As stated by the National Autism Society of Malaysia (NASOM), the number of children with autism in the organisation's intake has increased 30% over the last three years (NASOM, 2012). The increasing number of autism might be related to the changing diagnostic criteria (Levy, Mandell, & Schultz, 2009). Professionals such as psychiatrists and psychologists reported an increase in the number of children with autism in their clinics. However, currently there are only approximately 263 psychiatrists in Malaysia to serve a population of nearly 27 million, while there are only 50 psychologists who are registered with the professional organization (Toran, 2011).

The Education Act of 1996 has defined children with special needs as children with visual, hearing and learning disabilities. Moreover, children with learning disabilities include those with Down syndrome, autism, cognitive disabilities, speech and language difficulties and so on (Haq, 2000). In 2008, the Special Education Section managed the implementation of special education throughout the country with the vision "Quality Education for the Development of Excellent Students with Special Needs in Line with the National Educational System". Children with special needs including those with autism have the opportunity for education in the special schools as well as integrated programme and inclusion programme conducted in mainstream schools (Hussin, Loh, & Quek, 2008).